

HEAT EXCHANGER OF VENTILATING SYSTEM

TECHNICAL FIELD

The present invention relates to a heat exchanger for exchanging indoor
5 air and outdoor air and, more particularly, to a heat exchanger of a ventilating
system that is capable of exchanging sensible heat and latent heat between
indoor air and outdoor air.

BACKGROUND ART

10 In general, a ventilating system, a device intended for discharging foul
indoor air to outside a building and sucking outdoor fresh air into the interior of the
building, includes an air cleaner for removing dusts and foreign materials
contained in indoor air and a heat exchanger for transferring heat of indoor air
being discharged to outdoor air being sucked.

15 Figure 1 is a perspective view of a general ventilating system.

As illustrated, the ventilating system includes a case 2 mounted in a wall
of a building which sections an outdoor side and an indoor side; blast fans 4 and
6 inserted in the case 2 and performing a ventilating operation on air being sucked
and discharged, an air cleaner (not shown) installed at a portion in the case where
20 outdoor air is sucked and cleaning outdoor air being sucked, and a heat
exchanger 8 disposed inside the case 2 and performing heat exchanging between
indoor air being discharged to the exterior of the building and outdoor air being
sucked to the interior of the building

The case 2 is mounted penetrating the wall sectioning the indoor side and the outdoor side. Thus, one side of the case is positioned at the interior of the building while the other side is positioned at the exterior of the building. An outdoor suction opening 10 through which outdoor air is sucked and an outdoor discharge opening 12 through which indoor air is discharged are formed at the outdoor side of the case 2. An indoor discharge opening 14 through which outdoor air is supplied and an indoor suction opening 16 through which indoor air is sucked are formed at the indoor side of the case 2.

The discharging blast fans 4 is installed at one side of the outdoor discharge opening 12 and provides a blast pressure to discharge indoor air to outside of the building, and the sucking blast fan 6 is installed at one side of the indoor discharge opening 14 and provides a blast pressure to suck outdoor air to the interior of the building.

Figure 2 is a perspective view of a heat exchanger for a ventilating system in accordance with a conventional art, and Figure 3 is a partial perspective view of the heat exchanger.

A heat exchanger 8 in accordance with the conventional art includes: heat exchange plates 20 laminated with regular intervals so that a first air passage 26 through which indoor air passes and a second air passage 28 through which outdoor air passes are sequentially formed; first corrugation plates 22 attached to the first air passages 26 between the heat exchange plates 20 and obtaining a space for allowing indoor air to pass through; and second corrugation plates 24 attached to the second air passage 28 between the heat exchange plates 20 and

obtaining a space to allow outdoor air to pass through.

The heat exchange plates 20 are formed in a flat type, made of an aluminum material and carries out a heat exchanging operation between indoor air flowing through the first air passage 26 and outdoor air flowing through the
5 second air passage 28.

The first and second corrugation plates 22 and 24 are made of the same aluminum material as that of the heat exchange plates 20, and bent several times in a triangular form to obtain the space through which indoor air and outdoor air can pass.

10 With such a structure, the heat exchanger 8 is constructed overall in a rectangular form as the first corrugation plates 22, the heat exchange plates 20 and the second corrugation plates 24 are sequentially laminated.

When outdoor air passing the first corrugation plates 22 and indoor air passing the second corrugation plates cross to each other, heat exchanging is
15 carried out that heat of indoor air is transferred to outdoor air through the heat exchange plates 20.

The operation of the heat exchanger for a ventilating system constructed as described above in accordance with the conventional art will now be explained.

When the discharging blast fan 4 is driven, indoor air is sucked into the
20 indoor suction opening 16, passes the first air passage 26 and is discharged to the outside through the outdoor discharge opening 12.

And when the sucking blast fan 6 is driven, outdoor air is sucked into the outdoor suction opening 10, passes the second air passage 28 and is supplied

to the interior of the building through the indoor discharge opening 14.

At this time, as indoor air passing through the first air passages 26 of the first corrugation plates 22 and indoor air passing through the second air passages 28 of the second corrugation plates 24 flow crossing each other, heat of indoor air is transferred to outdoor air through the heat exchange plates 20 and outdoor air which has absorbed the heat of indoor air is supplied to the interior of the building.

In this manner, the outdoor air being sucked absorbs heat contained in indoor air being discharged and is discharged to the interior of the building, so that a rapid change in an indoor temperature is prevented in a ventilating operation.

However, the heat exchanger of a ventilating system of the conventional art has the following problem.

That is, since the heat exchanging plate 20, the first corrugation plate 22 and the second corrugation plate 24 are made of the aluminum material, heat transfer is possible that heat of indoor air is transferred to outdoor air in terms of the properties of the aluminum material. But since moisture contained in indoor air fails to be transferred to outdoor air, although the change in the indoor temperature can be reduced after the ventilating operation, a humidity changes.

DISCLOSURE OF THE INVENTION

Therefore, it is an object of the present invention to provide a heat exchanger of a ventilating system that is capable of exchanging latent heat that

outdoor air absorbs moisture contained in indoor air as well as exchanging sensible heat that heat contained in indoor air being discharged to outside a building is transferred to outdoor air being introduced into the interior of the building, thereby minimizing a change in an indoor temperature and humidity during a ventilating operation.

Another object of the present invention is to provide a heat exchanger of a ventilating system that is capable of improving an indoor environment by radiating negative ions to outdoor air being supplied to the interior of a building.

To achieve the objects, there is provided a heat exchanger of a ventilating system including: heat exchange plates laminated with regular intervals so that a first air passage through which indoor air being discharged to outside of a building passes and a second air passage through which outdoor air being introduced into the interior of the building passes are sequentially formed; first corrugation plates attached to the first air passage and obtaining a space to allow outdoor air to pass therethrough; and second corrugation plates attached to the second air passage and obtaining a space to allow outdoor air to pass therethrough, wherein the heat exchange plates are made of a paper material with numerous fine holes that are able to generate a capillary phenomenon and loess which radiates far infrared ray.

In the heat exchanger of a ventilating system in accordance with the present invention, the heat exchange plate is fabricated by mixing a Korean paper made of bast fiber of the paper mulberry as a key component and loess radiating far infrared ray.

In the heat exchanger of a ventilating system in accordance with the present invention, the Korean paper contains 60~70% of holo cellulose, 10~20% of lignin and 5~10% of lime.

5 In the heat exchanger of a ventilating system in accordance with the present invention, a process for fabricating the Korean paper includes the steps of: bundling the paper mulberry, putting it in a container with water, boiling it to a degree that its skin is easily peeled off, peeling and drying them; soaking the dried skin of the paper mulberry in the water, sorting out only the white bast fiber portion, putting the bast fiber portion in caustic soda and boiling it more than three
10 hours, and wringing it with a compressor; putting the moisture-removed bast fiber in a liquid which has been prepared by mashing roots of the paper mulberry and pressing them out, and mixing them evenly, and filtering the resulting paper solution by using a sieve.

In the heat exchanger of a ventilating system in accordance with the
15 present invention, the loess has particles with a size of 0.02~0.05mm.

In the heat exchanger of a ventilating system in accordance with the present invention, the loess has a composition of 60~65% silica (SiO_2), 10~13% alumina (Al_2O_3), 5~6% iron content, 1~3% of magnesium, 2~3% of potassium carbonate, and 6~9% lime.

20 In the heat exchanger of a ventilating system in accordance with the present invention, the first corrugation plate and the second corrugation plate are made of an aluminum material.

In the heat exchanger of a ventilating system in accordance with the

present invention, the first corrugation plate and the second corrugation plate are made of a paper material with numerous fine holes that are able to generate a capillary phenomenon and loess which radiates far infrared ray.

To achieve the objects, there is provided a heat exchanger of a ventilating system including: heat exchange plates laminated with regular intervals so that a first air passage through which indoor air being discharged to outside of a building passes and a second air passage through which outdoor air being introduced into the interior of the building passes are sequentially formed; first corrugation plates attached to the first air passage and obtaining a space to allow outdoor air to pass therethrough; and second corrugation plates attached to the second air passage and obtaining a space to allow outdoor air to pass therethrough, wherein the heat exchange plates are made of a Korean paper with numerous fine holes that are able to generate a capillary phenomenon and charcoal which radiates negative ions.

In the heat exchanger of a ventilating system in accordance with the present invention, the charcoal is fabricated by carbonizing a wood material at a temperature of 600~900°C and has carbon as a key component.

In the heat exchanger of a ventilating system in accordance with the present invention, the charcoal contains carbon of some 85%.

In the heat exchanger of a ventilating system in accordance with the present invention, the first corrugation plate and the second corrugation plate are fabricated with a Korean paper with numerous fine holes that are able to generate a capillary phenomenon and charcoal which radiates negative ions.

To achieve the objects, there is provided a heat exchanger of a ventilating system including: heat exchange plates laminated with regular intervals so that a first air passage through which indoor air being discharged to outside of a building passes and a second air passage through which outdoor air being introduced into the interior of the building passes are sequentially formed; first corrugation plates attached to the first air passage and obtaining a space to allow outdoor air to pass therethrough; and second corrugation plates attached to the second air passage and obtaining a space to allow outdoor air to pass therethrough, wherein the heat exchange plates are made of a paper material with numerous fine holes that are able to generate a capillary phenomenon and active carbon which has an air cleaning function.

In the heat exchanger of a ventilating system in accordance with the present invention, the active carbon is fabricated by processing wood or brown coal with chemicals such as zinc chloride or phosphoric acid, an activation agent and drying it, or by activating charcoal with steam.

In the heat exchanger of a ventilating system in accordance with the present invention, the first corrugation plate and the second corrugation plate are fabricated with a paper material with numerous fine holes that are able to generate a capillary phenomenon and active carbon which has an air cleaning function.

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BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a partially cut perspective view showing the construction of a general ventilating system;

Figure 2 is a perspective view of a heat exchanger of a ventilating system in accordance with a conventional art;

Figure 3 is a partial perspective view of the heat exchanger of a ventilating system in accordance with the conventional art;

5 Figure 4 is a perspective view of a heat exchanger of a ventilating system in accordance with a first embodiment of the present invention;

Figure 5 is an exploded perspective view of the heat exchanger of a ventilating system in accordance with the first embodiment of the present invention;

10 Figure 6 is an exploded perspective view of the heat exchanger of a ventilating system in accordance with a second embodiment of the present invention;

Figure 7 is an exploded perspective view of the heat exchanger of a ventilating system in accordance with a third embodiment of the present invention;

15 and

Figure 8 is an exploded perspective view of the heat exchanger of a ventilating system in accordance with a fourth embodiment of the present invention.

20 **MODES FOR CARRYING OUT THE PREFERRED EMBODIMENTS**

A heat exchanger of a ventilating system in accordance with preferred embodiments of the present invention will now be described with reference to the accompanying drawings.

There can be several embodiments of the heat exchanger of a ventilating system in accordance with the present invention, of which preferred ones will be described.

Figure 4 is a perspective view of a heat exchanger of a ventilating system
5 in accordance with one embodiment of the present invention.

With reference back to Figure 1, a ventilating system of the present invention includes a case 2 mounted penetratingly in a wall of a building which sections an outdoor side and an indoor side of the building. That is, one side of the case 2 is positioned at the exterior of the building while the other side of the
10 case 2 is positioned at the interior of the building.

The outdoor suction opening 10 through which outdoor air is sucked and an outdoor discharge opening 12 through which indoor air is discharged are respectively connected at the outdoor side of the case 2, while an indoor suction opening 14 through which indoor air is sucked and an indoor discharge opening
15 16 through which outdoor air is supplied to the interior of the building are connected at the indoor side of the case 2.

A discharging blast fan 4 is installed to at one side of the outdoor discharge opening 12 to give a blast pressure to indoor air to discharge it to the exterior of the building, and a sucking blast fan 6 is installed at one side of the indoor
20 discharge opening 14 to give outdoor air to suck it into the interior of the building.

An air cleaner (not shown) is installed on a suction passage inside the case 2 to remove various impurities and dusts contained in outdoor air being sucked to the interior of the building, and a heat exchanger 8 is installed inside the case

2 to carry out a heat exchanging operation between indoor air being discharge to the exterior of the building and outdoor air being sucked to the interior of the building.

As shown in Figure 4, the heat exchanger 8 includes heat exchange plates 54 laminated with predetermined intervals so that a first air passage 50 through which indoor air passes and a second air passage 52 through which outdoor air passes are sequentially formed; a first corrugation plate 56 attached on the first air passage 50 to obtain a space through which the indoor air passes; and a second corrugation plate 58 attached on the second air passage 52 to obtain a space through which the outdoor air passes.

The heat exchanger 8 has a rectangular form in an overall shape, and the first corrugation plate 56 and the second corrugation plate 58 are arranged to be crossed, so that indoor air and outdoor air flow in the crossing manner, during which heat exchange is carried out through the heat exchange plates 54.

The heat exchange plate 54 has a thin flat type and is made of a material which is able to pass moisture therethrough so that moisture contained in the indoor air flowing in the first air passage 50 can be transferred to outdoor air flowing in the second air passage 52, and which also has a cleaning function as well such as antibiosis and deodorization.

In other words, as shown in Figure 5, the heat exchange plate is fabricated by mixing a Korean paper material with an excellent moisture absorption rate and loess which performs a purification function of removing various harmful materials contained in the outdoor air as well as antibiotic and mothproof functions by

radiating far infrared ray to outdoor air being sucked to the interior of the building.

The Korean paper is fabricated by a Korean particular method, of which main ingredient is the bast fiber of paper mulberry.

The fabrication process of the Korean paper includes the steps of: bundling
5 the paper mulberry, putting it in a container with water, boiling it to a degree that its skin is easily peeled off, peeling and drying them; soaking the dried skin of the paper mulberry in the water, sorting out only the bast fiber portion, putting the bast fiber portion in caustic soda and boiling it more than three hours, and wringing it with a compressor; putting the moisture-removed bast fiber in a liquid which has
10 been prepared by mashing roots of the paper mulberry and pressing them out, and mixing them evenly, and filtering the resulting paper solution by using a sieve.

The Korean paper completed by the fabrication process contains 60~70% of holo cellulose, 10~20% of lignin and 5~10% of lime. More specifically, it is preferred that the Korean paper comprises 67.5% of holo cellulose, 14.7% of
15 lignin and 6.22% of lime.

Referring to the Korean paper, since its fibers are long in length, narrower in width, fibers are combined tightly, and in addition, since fibrils forming the fiber of cellulose are oriented in an axial direction, the fibers have a high strength. Thus, compared to the general paper, the Korean paper has such an advantage
20 that it can be preserved for a long period. In addition, the numerous fine holes formed between fibers generate the capillary phenomenon, resulting in an excellent moisture absorption capacity.

Accordingly, fabrication of the heat exchange plate 54 with the Korean

material ensures a latent heat function as moisture contained in indoor air is absorbed to the heat exchange plate 54, which is then transferred to outdoor air.

The loess is a sort of soil that can be easily collected from soil and has particles with a size of 0.02~0.05 mm and chemical components of 60~65% silica (SiO₂), 10~13% alumina (Al₂O₃), 5~6% of iron content, 1~3% of magnesium, 2~3% of potassium carbonate, and 6~9% lime, etc.

The loess has a mineral composition comprising 60~70% quartz, 10~20% feldspar and mica, 5~25% carbonate, 2~5% of other minerals.

Thanks to those advantages of the loess having the excellent antibiotic and deodorization functions and excellent purification function by radiation of far infrared ray, formation of the heat exchange plates with loess along with the Korean paper would ensure purification of outdoor air being supplied to the interior of the building after passing through the heat exchange plates and removal of various harmful materials contained in the outdoor air.

The loess is mixed in water to have a certain viscosity, which is then applied to the heat exchanging plate, thereby completing formation of the heat exchange plate. The loess and the Korean paper can be mixed in other various methods.

Preferably, the first corrugation plate 56 and the second corrugation plate 58 can be fabricated with an aluminum material.

The operation of the heat exchanger constructed as described above will now be described.

When the discharging blast fan 4 is driven, indoor air is sucked into the

indoor suction opening 16, passes through the first air passage 50 with the first corrugation plate 56 attached thereto and is discharged through the outdoor discharge opening 12 to the exterior of the building.

When the sucking blast fan 6 is driven, outdoor air is sucked into the outdoor suction opening 10, passes through the second air passage 52 with the second corrugation plate 58 attached thereto, and is supplied to the interior of the building through the indoor discharge opening 14.

As the indoor air passing through the first corrugation plate 56 and the outdoor air passing through the second corrugation plate 58 flow to cross to each other, heat exchange and moisture exchange are performed.

That is, the heat exchange plate 56 is made of the Korean paper material, so that a heat transfer performance of transferring heat of indoor air to outdoor air betters. And thanks to the capillary phenomenon occurring by the numerous fine holes formed in the heat exchange plate 54, moisture contained in the indoor air is absorbed to the heat transfer plate 56, which is then transferred to the outdoor air, according to which the outdoor air sucked to the interior of the building contains heat with a temperature as high as the indoor air being discharged to outside the building and moisture as much as that of the indoor air. Therefore, the temperature and moisture change in the indoor environment can be minimized in the ventilating operation.

In addition, since loess is contained in the heat exchange plate 54, far infrared ray is radiated to outdoor air being passed through the second air passage 52, performing a sterilization function and performing a purification

function to remove harmful materials contained in the outdoor air. Therefore, clean air is supplied to the interior of the building.

Figure 6 is a perspective view of a heat exchanger in accordance with a second embodiment of the present invention.

5 Including a heat exchange plate 70, a first corrugation plate 72 and a second corrugation plate 74, a heat exchanger in accordance with a second embodiment of the present invention has the same construction as that of the first embodiment of the present invention except that the heat exchange plate 70 is fabricated with a different material.

10 That is, the heat exchange plate 70 is made by mixing the Korean paper material with an excellent moisture absorption rate in transferring moisture contained in indoor air being discharged to outside the building to outdoor air being sucked to the interior of the building and charcoal which radiates negative ions to outdoor air being sucked to the interior of the building.

15 The Korean paper in this connection has the same construction and is fabricated in the same manner as those in the first embodiment of the present invention, descriptions of which are thus omitted.

Charcoal is made by primarily carbonizing wood at a temperature of 600~900°C, in which carbon accounts for as much as 85% as a major component.

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In the fabrication process of charcoal, numerous fine holes are formed in charcoal, so that various harmful materials can be adsorbed therethrough, and charcoal has an excellent air cleaning performance with its function of radiating

negative ions.

As stated above, the heat exchanger in accordance with the second embodiment of the present invention has such an advantage that since the heat exchange plate 70 is fabricated by mixing the Korean paper and charcoal, the sensible heat exchange and the latent heat exchange can be simultaneously carried out, which is a property of the Korean paper, and indoor air can be purified by radiating negative ions, a property of charcoal, to outdoor air being supplied to the interior of the building.

Figure 7 is an exploded perspective view of the heat exchanger of a ventilating system in accordance with a third embodiment of the present invention.

Including a heat exchange plate 80, a first corrugation plate 82 and a second corrugation plate 84, a heat exchanger in accordance with a third embodiment of the present invention has the same construction as that of the first embodiment of the present invention except that the heat exchange plate 70 is fabricated with a different material.

That is, the heat exchange plate 80 is made by mixing the Korean paper material with an excellent moisture absorption rate in transferring moisture contained in indoor air being discharged to outside the building to outdoor air being sucked to the interior of the building and an active carbon which removes a harmful material contained in the air.

The Korean paper in this connection has the same construction and is fabricated in the same manner as those in the first embodiment of the present invention, descriptions of which are thus omitted.

The active carbon has a strong adsorption and mostly made of carbon and is fabricated by processing wood or brown coal with chemicals such as zinc chloride or phosphoric acid, an activation agent and drying it, or by activating charcoal with steam.

5 As stated above, the heat exchanger in accordance with the second embodiment of the present invention has such an advantage that since the heat exchange plate 80 is fabricated by mixing the Korean paper and active carbon, the sensible heat exchange and the latent heat exchange can be simultaneously carried out, which is the property of the Korean paper, and a harmful material
10 contained in outdoor air being supplied to the interior of the building can be removed, which is the property of the active carbon.

Figure 8 is an exploded perspective view of the heat exchanger of a ventilating system in accordance with a fourth embodiment of the present invention.

15 Including a heat exchange plate 90, a first corrugation plate 92 and a second corrugation plate 94, a heat exchanger in accordance with a fourth embodiment of the present invention has the same construction as that of the first embodiment of the present invention except that the heat exchange plate 80, the first corrugation plate 92 and the second corrugation plate 94 are fabricated with
20 a different material.

That is, the heat exchange plate, the first corrugation plate and the second corrugation plate can be fabricated with a material obtained by mixing the Korean paper and loess, with a material obtained by mixing the Korean paper and

charcoal, or with a material obtained by mixing the Korean paper and active carbon.

As so far described, the heat exchanger of a ventilating system in accordance with the present invention has the following advantages.

5 That is, first, thanks to the Korean paper fabricated with loess, the sensible heat exchange that heat contained in indoor air being discharged to outside a building is transferred to outdoor air being sucked to the interior of the building and a latent heat exchange that moisture contained in indoor air being discharged to outside the building is transferred to outdoor air being sucked to the interior of the
10 building are simultaneously carried out. In addition, the far infrared ray radiated from loess performs a cleaning function of removing a harmful material contained in outdoor air, so that a change in temperature and humidity in the interior of the building can be minimized after a ventilating operation and air being supplied into the interior of the building can be cleaned.

15 Second, thanks to the heat exchanger fabricated with the Korean paper and charcoal, the sensible heat exchange that heat contained in indoor air being discharged to outside a building is transferred to outdoor air being sucked to the interior of the building and a latent heat exchange that moisture contained in indoor air being discharged to outside the building is transferred to outdoor air
20 being sucked to the interior of the building are simultaneously carried out. In addition, the negative ions radiated from charcoal performs a cleaning function of removing a harmful material contained in outdoor air, so that a change in temperature and humidity in the interior of the building can be minimized after a

ventilating operation and a clean air can be supplied into the interior of the building.

Lastly, thanks to the heat exchanger fabricated with the Korean paper and the active carbon, the sensible heat transfer and the latent heat transfer are
5 simultaneously carried out, so that air being supplied to the interior of the building can be purified.

It will be apparent to those skilled in the art that various modifications and variations can be made in the heat exchanger of a ventilating system of the present invention without departing from the spirit or scope of the invention. Thus,
10 it is intended that the present invention cover modifications and variations of this invention provided they come within the scope of the appended claims and their equivalents.